Building a Thermometer Activity Sheet

Duplicate and distribute to students.

Purpose

To help you understand how and why a liquid-in-glass thermometer works.

Overview

The soft drink bottle thermometer that you construct in this activity is similar to the thermometer you use in the GLOBE Instrument Shelter. However, there are differences. Both use liquids, but the liquids are different. Do you know what liquid is in the standard GLOBE thermometer? Also, the thermometer you will make has no degree markings. But the principles of operation are the same for both types of thermometers.

The thermometer you use for measurements and the instruments you will build are both based on the principle that substances expand and contract as their temperature changes.

This lab also demonstrates the principle of heat transfer. When a warm object is placed against a cold object heat is transferred from the warm object to the cold object by conduction. For example, in the winter if you place your bare hand on the fender of an automobile, your hand transfers heat to the metal by conduction.

Usually when you work in a job, you are part of a team. In this activity you will also be part of a team. Here are your job descriptions:

Student 1 – assembler - gathers materials and assembles the thermometer
Student 2 – timer/reporter - uses clock or watch to keep track of 2-minute intervals when the experiment starts - makes marks on the straw showing how much the water has moved - measures the straw at the end of the experiment and tells recorder the measurements - reports to the class the results of the experiment
Student 3 – recorder - records the measurements that the timer has made - also transfers the group's measurements onto the class chart

Materials and Tools

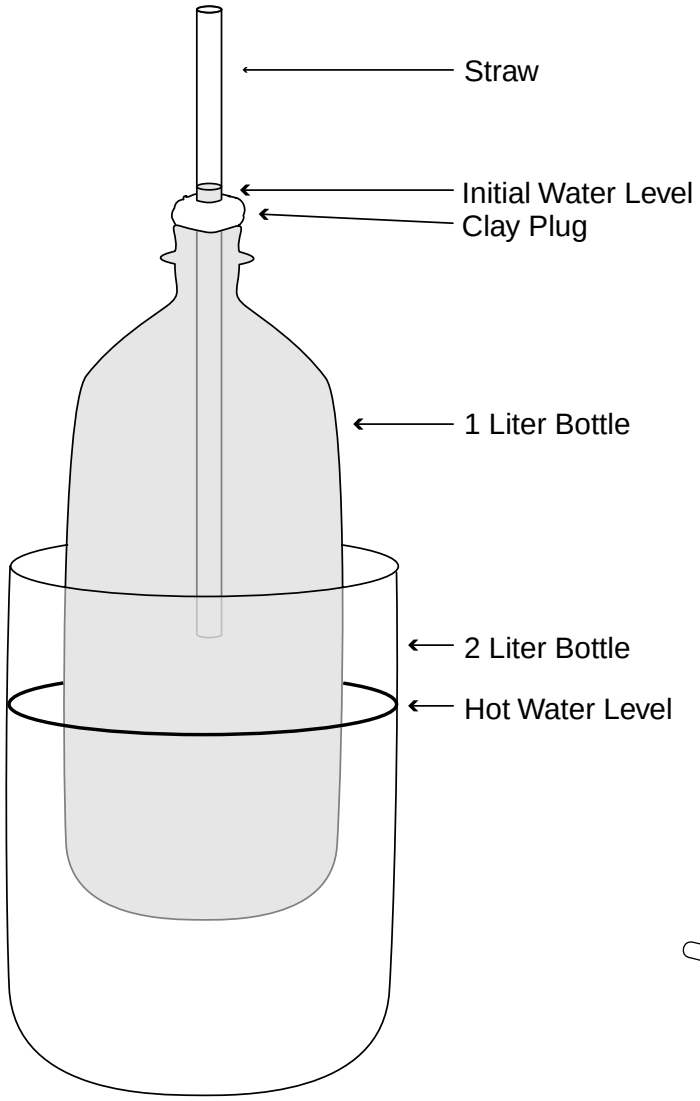
(per group of students)

Ice
Water
One liter plastic soda bottle
Clear or white plastic drinking straw
Modeling clay (a ball about 25 mm in diameter)
Scissors or knife to cut the top off the two liter plastic bottle
2 two-liter plastic soda bottles - the top of the bottle needs to be cut off so that it is used as a container to hold water and the 1 liter plastic soda bottle
Food coloring (yellow doesn't work as well as red, blue, and green)
Watch or clock with second hand
Metric ruler
Marker, grease pencil, or pen to make marks on the side of the straw

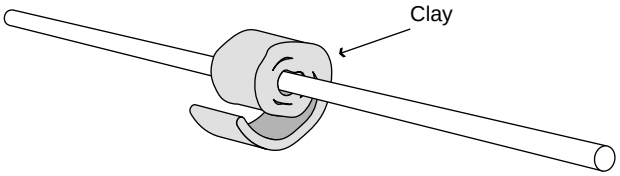
Duplicate and distribute to students.

Building the Thermometer

1. Fill the one liter soft drink bottle to the very top of the lip with cold tap water.
2. Add four drops of food coloring – this helps make the water line easier to see. Blue, green, or red work best.



3. Roll some modeling clay into a small ball about 25 mm in diameter. Then roll it out so that it forms a cylinder about the length and diameter of a pencil. Flatten the pencil-shaped clay into a thick ribbon. Wrap the ribbon around the midpoint of the straw.
4. Place the straw into the bottle and use the clay to seal off the bottle. In doing this, be careful not to pinch the straw closed. You also do not want any holes or cracks in the clay that would allow water to escape. One half of the straw will be inside the bottle and one half will be outside the bottle. Press the clay plug into the neck of the bottle far enough to force the water level up into the straw so that it can be seen.



Experiment

1. Place the filled one liter bottle (the soft drink bottle thermometer) into the empty two liter plastic bottle container. Place a mark on the straw where you see the water line.
2. Fill the two liter container with hot tap water. Wait two minutes. Mark the straw at the water line. Repeat this marking every two minutes, for ten minutes. At the end of ten minutes use a ruler to measure the distance of each mark from the original water mark at the bottom of the straw. Record your measurements on the team data sheet, below.

Duplicate and distribute to students.

Team Data Sheet

Time	*Measurements in millimeters*
2 minutes	
4 minutes	
6 minutes	
8 minutes	
10 minutes	

Watch closely for any changes. Do you see any? Describe what you observe.

_____

_____

3. Put ice and cold water into the second two-liter container.

4. Place the thermometer bottle into the ice water. Record your observations.

_____

_____

_____

_____

5. What happens to the water level in the straw when the thermometer is placed in hot water?

_____

_____

_____

What happens to the water level in the straw when the thermometer is placed in cold water?

_____

_____

_____

6. Explain why you think these changes happen.

_____

_____

_____

7. Using your answers to question 6, how does the maximum-minimum thermometer used for the GLOBE measurements work?

_____

_____

_____

8. What are two other things (variables) that, if changed, might cause this experiment to work differently?

_____

_____

_____

9. Graph the measurements that you recorded in your team data sheet at step number 2. The x-axis (horizontal) should be the time (in minutes) and the y-axis (vertical) should be your measurements (in millimeters) from the original line before the hot water was added. Be sure to give your graph a title and to label the axes of the graph so that someone else could understand it.

10. Record your data on the Class Data Sheet on the board or as your teacher instructs. Combine your data with that of your classmates to find the average movement of water for each two-minute time period.

11. Add the average figures for the movement of water to your own graph. Be sure to label this new line. How is the graph of your measurements different from the graph of the class average?

_____

_____

_____

_____

12. Explain the graph. What story does your graph tell? Can you draw any conclusions?

_____

_____

_____

_____

13. Why might it be important to have more than one trial when you are drawing conclusions?

_____

_____

_____

_____